

Decision Rationale

Total Maximum Daily Loads for The Primary Contact Use (Bacteriological) Impairments on Little Dark Run and Robinson River

I. Introduction

The Clean Water Act (CWA) requires a Total Maximum Daily Load (TMDL) be developed for those water bodies identified as impaired by a state where technology-based and other controls will not provide for attainment of water quality standards. A TMDL is a determination of the amount of a pollutant from point, nonpoint, and natural background sources, including a margin of safety (MOS), that may be discharged to a water quality-limited water body.

This document will set forth the U. S. Environmental Protection Agency's (EPA) rationale for approving the TMDLs for the primary contact use (bacteriological) impairments on the Little Dark Run and Robinson River. EPA's rationale is based on the determination that the TMDLs meet the following eight regulatory conditions pursuant to 40 CFR §130.

- 1) The TMDLs are designed to implement applicable water quality standards.
- 2) The TMDL include a total allowable load as well as individual waste load allocations (WLAs) and load allocations(LAs).
- 3) The TMDLs consider the impacts of background pollutant contributions.
- 4) The TMDLs consider critical environmental conditions.
- 5) The TMDLs consider seasonal environmental variations.
- 6) The TMDLs include a MOS.
- 7) There is reasonable assurance that the TMDLs can be met.
- 8) The TMDLs have been subject to public participation.

II. Background

The Little Dark Run and Robinson River Watersheds are located in Madison and Culpeper Counties, Virginia. The Little Dark Run watershed is approximately 2,000 acres in size. The impaired segment is 4.26 miles in length running from its headwaters to its confluence with Dark Run. The rural watershed is made up of mostly forested (58 percent) and agricultural (29 percent) land. There are two impaired segments of Robinson River. The Upper Robinson River segment runs 3.65 miles from its confluence with Rose River to its confluence with Leathers Run. The 30,000 acre Upper Robinson River Watershed is rural as well with forested (84 percent) and agricultural (16 percent) lands making up the entire watershed. The Lower Robinson River segment runs approximately 5.21 miles from its confluence with White Oak Run to its mouth, its confluence with the Rapidan River. The Lower Robinson River Watershed is

approximately 124,000 acres and has a similar land use composition to the upper segment with forested (64 percent) and agricultural (34 percent) lands making up most of the watershed.

In response to Section 303(d) of the CWA, the Virginia Department of Environmental Quality (VADEQ) listed Little Dark Run and Robinson River on Virginia's Section 303(d) lists as being unable to attain their applicable criteria. Table 1 documents the impairments and year of initial listing for each segment. The decision to list for bacteria (fecal coliform) was based on observed violations of the Commonwealth's bacteriological criteria. This decision rationale addresses the bacteria impairments only.

Table #1 – Robinson River TMDL Impairments

Segment	Stream Name	Initial Listing	Impairments
VAN-E15R-01	Little Dark Run	1994	Fecal Coliform
VAN-E14R-01	Upper Robinson River	2002	Fecal Coliform, Temperature
VAN-E15R-02	Lower Robinson River	2004	Fecal Coliform

Fecal coliform is a bacterium which can be found within the intestinal tract of all warm blooded animals. Therefore, fecal coliform can be found in the fecal wastes of all warm blooded animals. Fecal coliform in itself is not a pathogenic organism. However, fecal coliform indicates the presence of fecal wastes and the potential for the existence of other pathogenic bacteria. The higher concentrations of fecal coliform indicate the elevated likelihood of increased pathogenic organisms.

EPA encouraged the states to use e-coli and enterococci as the indicator species instead of fecal coliform. A better correlation was drawn between the concentrations of e-coli and enterococci, and the incidence of gastrointestinal illness. The Commonwealth adopted e-coli and enterococci criteria in January 2003. According to the new criteria, streams will be evaluated via the e-coli and enterococci criteria after 12 samples have been collected using these indicator species. The fecal coliform criteria will be used in the interim. Twelve e-coli samples were collected from the impaired waters addressed under the TMDL.

As Virginia designates all of its waters for primary contact, all waters are required to meet the bacteriological standard for primary contact. Virginia's standard applies for all flows, there are no high or low flow exemptions. The fecal coliform criteria was modified in 2003 to require that the fecal coliform concentration not exceed a geometric mean of 200 colony forming units (cfu) per 100 milliliters (ml) of water for two or more samples collected over a month, nor shall more than 10 percent of the total samples exceed 400 cfu/100 ml of water. The new criteria also established concentration based requirements for e-coli. The e-coli criteria requires a geometric mean concentration of 126 cfu/100 ml of water with no sample exceeding 235 cfu/100 ml of water. Unlike the fecal coliform criteria, which allows a 10 percent violation rate, the new e-coli

criteria requires the concentration of e-coli not exceed 235 cfu/100 ml of water. This caps the allowable concentration of bacteria and requires extremely stringent load reductions for attainment.

Although the TMDL and criteria require the 235 cfu/100 ml of water of water for e-coli not be exceeded, waters are not placed on the Section 303(d) list if their violation rate does not exceed 10 percent. Therefore, these tributaries may be deemed as attaining the primary contact use prior to the implementation of all of their TMDL reductions. It is necessary to keep this in mind because of the reductions required to attain the instantaneous criteria for e-coli in the model.

Through the development of this and other similar TMDLs, it was discovered that natural conditions (wildlife contributions to the streams) could cause or contribute to violations of the bacteria criteria. Bacterial source tracking sampling data collected from the impaired segments demonstrated that bacteria from wildlife represents a significant portion of the total bacterial load. In some instances, the loads from wildlife alone appear to violate the numeric criteria. Many of Virginia's TMDLs, including these TMDLs, have called for some reduction in the amount of wildlife contributions to the impacted streams. EPA believes that a significant reduction in wildlife is not practical and will not be necessary due to the implementation plan discussed below. It should be noted that in order for the impaired waters to be in compliance approximately 90 percent of the time, no reductions are required from wildlife sources. This would be the violation rate necessary for the water to be assessed as attaining criteria for 303(d) listing purposes and corresponds to the Stage 1 implementation goals identified in the TMDLs.

A phased implementation plan will be developed for all streams in which the TMDL calls for reductions in wildlife. In Phase 1 of the implementation, the Commonwealth will begin implementing the reductions (other than wildlife) called for in the TMDL. In Phase 2, which can occur concurrently to Phase 1, the Commonwealth will consider addressing its standards to accommodate this natural loading condition. The Commonwealth has indicated that during Phase 2, it may develop a Use Attainability Analysis (UAA) for streams with wildlife reductions which are not used for frequent bathing. Depending upon the result of the UAA, it is possible that these streams could be designated for secondary contact.

After the completion of Phase 1 of the implementation plan, the Commonwealth will monitor the stream to determine if the wildlife reductions are actually necessary, as the violation level associated with the wildlife loading may be smaller than the percent error of the model. In Phase 3, the Commonwealth will investigate the sampling data to determine if further load reductions are needed in order for these waters to attain standards. If the load reductions and/or the new application of standards allow the stream to attain standards, then no additional work is warranted. However, if standards are still not being attained after the implementation of Phases 1 and 2, further work and reductions will be warranted.

The TMDL Report submitted by Virginia is designed to determine the acceptable load of

e-coli which can be delivered to the impaired waters, as demonstrated by the use of the Hydrologic Program Fortran (HSPF)¹ in order to ensure that the water quality standard is attained and maintained. HSPF was considered an appropriate model to analyze the impaired water because of its dynamic ability to simulate both watershed loading and receiving water quality over a wide range of conditions. The model was run to determine the fecal coliform loading to the impaired streams as most of the loading information and sampling results are based on fecal coliform. The in-stream fecal coliform concentrations were then converted to e-coli using a conversion factor established by the Commonwealth.

The TMDL analysis allocates the application/deposition of fecal coliform to land-based and in-stream sources. For land based sources, the HSPF model accounts for the buildup and washoff of pollutants from these areas. Buildup (accumulation) refers to the complex spectrum of dry-weather processes that deposit or remove (die-off) pollutants between storms.² Washoff is the removal of fecal coliform which occurs as a result of runoff associated with storm events. These two processes allow the HSPF model to determine the amount of fecal coliform from land based sources which is reaching the stream. Point sources and wastes deposited directly to the stream were treated as direct deposits. Wastes which are deposited directly to the stream do not need a transport mechanism. Local rainfall and temperature data were needed to develop the model. Weather data provides the precipitation data which drives the TMDL model. Weather data was collected from National Climatic Data Center weather stations within the watersheds.

Stream flow data was available from United States Geological Survey (USGS) gauge 01666500 which is located on Robinson River near Locust Dale, Virginia. This allowed the modelers to calibrate and validate the hydrologic model to observed flow data within the watershed. Since Little Dark Run is a tributary to the Robinson River, the model was developed for both waters. The model was calibrated to observed data collected at the USGS gauge from October 1993 through September 1998. The data covered a wide range of hydrologic conditions and seasonal variations. During the calibration period, the modeling parameters are manipulated within their acceptable ranges in order to have the simulated flow correspond to the observed conditions. To insure that the model is accurately predicting the stream's responses, the model is compared to a different set of observed flow data using the corresponding weather data. This is called the validation process. The validation for the Robinson River TMDL had run from data collected from October 1989 through September 1993.

The TMDLs were modeled using fecal coliform loading rates as was done in previous TMDL efforts. The fecal coliform concentrations were then converted to e-coli concentrations

¹Bicknell, B.R., J.C. Imhoff, J.L. Little, and R.C. Johanson. 1993. Hydrologic Simulation Program-FORTRAN (HSPF): User's Manual for release 10.0. EPA 600/3-84-066. U.S. Environmental Protection Agency, Environmental Research Laboratory, Athens, GA.

²CH2MHILL, 2000. Fecal Coliform TMDL Development for Cedar, Hall, Byers, and Hutton Creeks Virginia.

using a translator equation developed by VADEQ. Significant reductions in the modeled load were required in order for the impaired streams to attain the e-coli criteria in the model. Table 2 summarizes the specific elements of each TMDL.

Table #2 - Summarizes the Specific Elements of the TMDLs.

Stream Name	TMDL (cfu/yr)	WLA (cfu/yr)	LA (cfu/yr)	MOS (cfu/yr)
Little Dark Run	8.78E+14	1.39E+11	8.78E+13	Implicit
Upper Robinson River	9.30E+13	5.04E+09	9.30E+13	Implicit
Lower Robinson River	3.25E+14	5.03E+10	3.25E+14	Implicit

The United States Fish and Wildlife Service has been provided with a copy of the TMDL Report.

III. Discussion of Regulatory Conditions

EPA finds that Virginia has provided sufficient information to meet all of the eight basic requirements for establishing a primary contact (bacteriological) impairment TMDLs for the Little Dark Run and Robinson River Watersheds. EPA is therefore approving these TMDLs. EPA's approval is outlined according to the regulatory requirements listed below.

1) The TMDLs are designed to meet the applicable water quality standards.

Virginia has indicated that excessive levels of fecal coliform due to nonpoint sources (both wet weather and directly deposited nonpoint sources) have caused violations of the water quality criteria and designated uses on Little Dark Run and the Robinson River. The water quality criterion for fecal coliform was a geometric mean 200 cfu/100 ml or an instantaneous standard of no more than 1,000 cfu/100 ml. Two or more samples over a 30-day period are required for the geometric mean standard. Since the state rarely collects more than one sample over a 30-day period, most of the samples were measured against the instantaneous standard.

The Commonwealth has changed its bacteriological criteria as indicated above. The new criteria require that the fecal coliform concentration not exceed a geometric mean of 200 cfu per 100 ml of water for two or more samples collected over a month nor shall more than 10 percent of the total samples exceed 400 cfu/100 ml of water. The new e-coli criteria requires a geometric mean of 126 cfu/100 ml of water with no sample exceeding 235 cfu/100 ml of water. Based on the 2004 Section 303(d) assessment period data, a 26 percent violation rate was exhibited in Little Dark Run, Upper Robinson River and the Lower Robinson River.

The HSPF model was used to determine the fecal coliform deposition rates to the land as well as loadings to the stream from direct deposit sources. Once the existing load was determined, allocations were assigned to each source category to develop a loading pattern that would allow Little Dark Run and the Robinson River to support the e-coli water quality criterion and primary contact use. The following discussion is intended to describe how controls on the

loading of e-coli to these waters will ensure that the criterion is attained.

The TMDL modelers determined the fecal coliform production rates within the watershed. Data used in the model was obtained from a wide array of sources, including farm practices in the area, the amount and concentration of farm animals, animal access to the stream, manure application rates, wildlife in the watershed, wildlife fecal production rates, landuses, weather, stream geometry, etc. The model combined all of the data to determine the hydrology and water quality of the stream.

The land within the watersheds were categorized into specific landuses. The landuses had specific loading rates and characteristics that were defined by the modelers. Therefore, the loading rates are different in lands defined as forested versus pasture. Pasture lands support cattle and are influenced differently by stormwater runoff.

The Robinson River TMDL model was run using weather data collected from local National Climatic Data Center weather stations. The stations were Culpeper, Big Meadows and Madison. This data was used to determine the precipitation rates in the watershed which transports the on land pollutants to the streams through overland and groundwater flows. Waste that was deposited to the land or stored was subjected to a die-off rate. The longer fecal coliform stayed on the ground, the greater the die-off was. Materials that were washed off the surface shortly after deposition were subjected to less die-off.

As stated above, the model for the Robinson River TMDL was calibrated and validated to USGS gauge data collected within the watershed. The gauge data used for calibration and validation was collected from 1989 through 1998. The water quality models were calibrated and validated against observed data collected from each of the streams from 1990 through 1998. The water quality model simulated the observed violations of the bacteria criteria. The bacterial loadings simulated within the model were reduced until the applicable criteria was attained.

2) The TMDLs include a total allowable load as well as individual waste load allocations and load allocations.

Total Allowable Loads

Virginia indicates that the total allowable loading is the sum of the LAs to land based precipitation driven nonpoint source areas (forest and agricultural land segments) and point sources. Activities that increase the levels of bacteria to the land surface or their availability to runoff are considered flux sources. The actual value for total loading can be found in Table 2 of this document. The total allowable load is calculated on an annual basis.

Waste Load Allocations

EPA regulations require that an approvable TMDL include individual WLAs for each point source. According to 40 CFR § 122.44(d)(1)(vii)(B), "Effluent limits developed to protect

a narrative water quality criterion, a numeric water quality criterion, or both, are consistent with assumptions and requirements of any available WLA for the discharge prepared by the state and approved by EPA pursuant to 40 CFR § 130.7.” Furthermore, EPA has authority to object to the issuance of any National Pollutant Discharge Elimination System (NPDES) permit that is inconsistent with the WLAs established for that point source.

Virginia has stated that there are nine regulated (NPDES) point sources discharging bacteria within Little Dark Run and the Robinson River. Seven of these dischargers are single family treatment units which are permitted under a general permit and are allowed to discharge 1,000 gallons of effluent per day with an e-coli concentration of 126 cfu/100 ml. The two other facilities have a daily flow of 80,000 and 25,000 gallons per day with the same effluent concentration limit. Table 3 documents the WLAs for each impaired segment.

Table #3 – WLAs for the Impaired Segments

Permit Number	Facility	Stream Segment	Flow (gpd)	WLA (cfu/yr)
VAG406152	Single Family Unit	Upper Robinson River	1,000	1.69E+10
VAG406006	Single Family Unit	Upper Robinson River	1,000	1.69E+10
VAG406189	Single Family Unit	Upper Robinson River	1,000	1.69E+10
VA0022845	Rapidan Service	Little Dark Run	80,000	1.39E+11
VA0068951	Heartland Institute	Lower Robinson River	25,000	4.35E+10
VAG406285	Single Family Unit	Lower Robinson River	1,000	1.69E+10
VAG406304	Single Family Unit	Lower Robinson River	1,000	1.69E+10
VAG406303	Single Family Unit	Lower Robinson River	1,000	1.69E+10
VAG406194	Single Family Unit	Lower Robinson River	1,000	1.69E+10

Load Allocations

According to Federal regulations at 40 CFR 130.2(g), LAs are best estimates of the loading, which may range from reasonably accurate estimates to gross allotments, depending on the availability of data and appropriate techniques for predicting loading. Wherever possible, natural and nonpoint source loads should be distinguished.

In order to accurately simulate landscape processes and nonpoint source loadings, VADEQ used the HSPF model to represent the impaired watersheds. The HSPF model is a comprehensive modeling system for the simulation of watershed hydrology, point and nonpoint source loadings, and receiving water quality. HSPF model used precipitation data for continuous and storm event simulation to determine total loading to the impaired segments from the various

landuses within the watersheds. Tables 4a - c list the LAs for Little Dark Run and the Robinson River segments. The reductions needed to insure that the instantaneous criteria are attained at all times are extremely stringent. As mentioned above, the Stage 1 implementation goal does not require any reductions to wildlife loadings and would attain a violation rate of less than 10

percent.

Table 4a - LA for Bacteria (fecal coliform) for Upper Robinson River

Source Category	Existing Load (cfu/yr)	Proposed Load (cfu/yr)	Percent Reduction
Straight Pipes	8.09E+13	0.00	100
Livestock In-Stream	1.76E+12	0.00	100
Wildlife In-Stream	5.93E+13	5.46E+13	8
Residential	1.61E+14	0.00	100
Cropland	1.16E+13	0.00	99
Pasture	2.95E+14	0.00	100
Forest	9.99E+15	2.71E+14	8

Table 4b - LA for Bacteria (fecal coliform) for Little Dark Run

Source Category	Existing Load (cfu/yr)	Proposed Load (cfu/yr)	Percent Reduction
Straight Pipes	4.97E+12	0.00	100
Livestock In-Stream	2.29E+12	0.00	100
Wildlife In-Stream	4.67E+12	4.67E+12	0
Residential	8.97E+13	0.00	100
Cropland	8.48E+11	0.00	100
Pasture	2.01E+15	0.00	100
Forest	1.97E+13	1.97E+13	0.00

3) The TMDLs consider the impacts of background pollution.

The TMDLs consider the impact of background pollutants by considering the bacteria load from background sources like wildlife.

4) The TMDLs consider critical environmental conditions.

According to EPA's regulation 40 CFR § 130.7 (c)(1), TMDLs are required to take into account critical conditions for stream flow, loading, and water quality parameters. The intent of this requirement is to ensure that the water quality of the impaired segments is protected during times when it is most vulnerable.

Critical conditions are important because they describe the factors that combine to cause a violation of water quality standards and will help in identifying the actions that may have to be undertaken to meet water quality standards³. Critical conditions are a combination of environmental factors (e.g., flow, temperature, etc.), which have an acceptably low frequency of occurrence. In specifying critical conditions in the waterbody, an attempt is made to use a reasonable "worst-case" scenario condition. For example, stream analysis often uses a low-flow (7Q10) design condition because the ability of the waterbody to assimilate pollutants without exhibiting adverse impacts is at a minimum.

The HSPF models were run over a multi-year period that exhibited a wide range of climatic conditions. The allocations developed in the TMDLs will therefore insure that the criterion is attained over a wide range of environmental conditions including wet and dry weather conditions.

5) The TMDLs consider seasonal environmental variations.

Seasonal variations involve changes in stream flow and loadings as a result of hydrologic and climatological patterns. In the continental United States, seasonally high flows normally occur in early spring from snow melt and spring rain, while seasonally low flows typically occur during the warmer summer and early fall drought periods.

Bacteria loadings also change during the year based on crop cycles, waste application rates, and cattle access patterns. Consistent with our discussion regarding critical conditions, the HSPF model and TMDL analysis effectively considered seasonal environmental variations through the use of observed weather data over an extended period of time and by modifying waste application rates, crop cycles, and livestock practices.

6) The TMDLs include a margin of safety.

This requirement is intended to add a level of safety to the modeling process to account for any uncertainty. The MOS may be implicit, built into the modeling process by using conservative modeling assumptions, or explicit, taken as a percentage of the WLA, LA, or

³EPA memorandum regarding EPA Actions to Support High Quality TMDLs from Robert H. Wayland III, Director, Office of Wetlands, Oceans, and Watersheds to the Regional Management Division Directors, August 9, 1999.

TMDL. Virginia included an implicit MOS in the TMDLs through the use of conservative modeling assumptions in the determination of bacteria loadings and production.

7) There is a reasonable assurance that the TMDLs can be met.

EPA requires that there be a reasonable assurance that the TMDLs can be implemented. WLAs will be implemented through the NPDES permit process. According to 40 CFR § 122.44(d)(1)(vii)(B), the effluent limitations for an NPDES permit must be consistent with the assumptions and requirements of any available WLA for the discharge prepared by the state and approved by EPA. Furthermore, EPA has authority to object to issuance of an NPDES permit that is inconsistent with WLAs established for that point source.

Nonpoint source controls to achieve LAs can be implemented through a number of existing programs such as Section 319 of the CWA, commonly referred to as the Nonpoint Source Program.

8) The TMDLs have been subject to public participation.

Three public meetings were held for the Robinson River TMDLs. The meetings were held on September 14, 2004, January 18, 2005 and May 17, 2005. All three meetings were held at the War Memorial Building in the Town of Madison, Virginia. The meetings were all noticed in the Virginia Register and subject to a 30-day comment period. One written comment was submitted following the third public meeting.